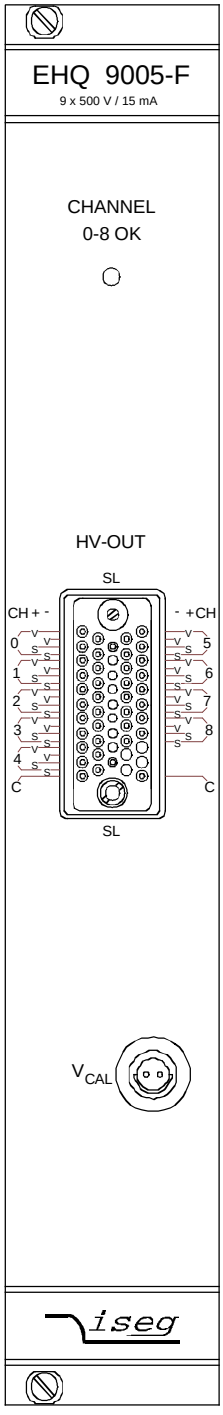
9-channel High Voltage Power Supply EHQ 9005-F

The EHQ 9005-F is a 9-channel high voltage power supply in 6U Eurocard format. Each single channel is independently controllable. The outputs (V-) und (V+) of each channel are both floating against each other and against ground.
The EHQ 9005-F is made ready for mounting into a crate. It is also possible to supply the modules separately with the necessary power. The unit is software controlled via CAN Interface directly through a PC or similar controller. With the CAN Controller MHCC 64 it is possible to create a multi-channel high voltage system of any configurable size. The HV output at the EHQ 9005-F is available with a REDEL-Connector or similar.

Technical data

	EHQ 9005 - F
Output current I_O	max. 15 mA (at 300 V)
Output voltage V_O	0 to 500 V
Floating	Connector (V-) to GND: ≤ |15 V| Connector (V+) to GND: ≤ |15 V + V_O|
Ripple and noise	f = 10 Hz to 100 kHz: < 10 mV (at max. load and f > 100 kHz: < 2 mV V_O > 50 V)
Hardware current limit I_{max}	Potentiometer internal
Interface	CAN-Interface
Voltage setting	Via software, resolution 1 mV
Voltage measurement	Via software, resolution 1 mV
Current measurement	Via software, resolution 100 nA
Accuracy of voltage measurement	± 20 mV
Accuracy of current measurement	± (0,01% ∗ I_O + 0,05% ∗ $I_{O\,max}$ + 1 digit)
Temperature coefficient	< 5 ∗ $10^{-5}/_K$
Stability	< 20 mV (no load/load and Δ V_{IN})
Rate of change of output voltage	Via software: 0,2 V/s to 50 V/s resolution 0,1 V
Channel control via software	Status 9 bit: channel error, KILL- enable, channel emergency cut-off, ramp, channel on/off, input error, current trip, sense error
8 (1) channels error control via software	Current limit ("Channels 0-8 OK" is signalled if no limits have been exceeded.)
Error signal	Green LED at "Channels 0-8 OK"
Protection loop (I_s); SL-contacts on the REDEL	5 mA < I_s < 20 mA ⇒ module on I_s < 0,5 mA ⇒ module off
Power requirements V_{IN}	+ 24 V (< 4 A) and + 5 V (< 0,5 A)
Packing	9-channels in 6U Euro cassette (40,64 mm wide and 220 mm deep)
Connector	96-pin connector according to DIN 41612
HV connector	40-pin REDEL-Connector



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Handling

The supply voltages and the CAN interface is connected to the module via a 96-pin connector on the rear side of the module.

The 9-channel Module EHQ 9005-F is assembled of two sub-modules (8 channels / 1 channel), each controlled independently via an own CAN identifier.

The maximum output current for each channel is defined through the position of an internal potentiometer ($I_{max}0$ to $I_{max}7$ corresponding to channel 1 to 8 and $I_{max}0$ to channel 9).
The output current will be limited to this setting value after it exceeds the threshold and the green LED on the front panel is 'OFF'.

A safety loop will be installed with the help of the upper and lower SL contacts (on the middle contact bank) from the REDEL-Connector. If the safety loop is active then output voltage is present only if a current is flowing in a range of 5 to 20 mA of any polarity (i.e. safety loop is closed). If the safety loop is opened during operation then the output voltages are shut off without ramp and the corresponding bit in the 'Status module' will be cancelled. After the loop will be closed again the channels must be switched 'ON' and a new set voltage must be given before it is able to offer an output voltage. The pins of the loop are potential free, the internal voltage drop is ca. 3 V. Coming from the factory the safety loop is not active (the corresponding bit is always set). Removing of an internal jumper makes the loop active (s. App. A).

The connector (V-) of each channels should be connected to ground at a certain chosen point. Otherwise it must be sure, that the potential between (V-) and GND should not exceed the amount of $|15\ V|$.

The sense line (S-) and (S+) has to be connected to the load without any exception. Otherwise the output voltage V_O is ca. 20 V above of the given $V_{set.}$

Pin assignment 96-pin connector according to DIN 41612:

PIN		PIN		PIN		Data
a1 a3 a5		b1 b3 b5		c1 c3 c5		+5V +24V GND
a11		b11		c11		@CAN_GND ⎫ @CANL ⎬ potential free @CANH ⎭
a13						RESET
		b13				OFF with ramp (e.g. 10s after power fail)
a30 a31 a32	A4 A2 A0	b30 b31 b32	A5 A3 A1	c30 c31 c32	GND GND GND	⎫ ⎬ Address field ⎭ module address (A0 ... A5)

The hardware signal "OFF with ramp" (Pulse High-Low-High, pulse width ≤ 100 µs) on pin b13 will be shut off the output voltage for all channels with a ramp analogue to the Group access "Channel ON/**OFF"**. The ramp speed is defined to V_{OUTmax} / 50 s. This is the actually module ramp speed after "OFF with ramp".
With help of the Group access "Channel **ON**/OFF**"** all channels are switched "ON" again.

With the address field a30/b30 ..... a32/b32 the module address will be coded.
(see item 4.4, description 11bit-Identifier).
Connected to GND ⇒ A(n) = 0 ; contact open ⇒ A(n) = 1

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Communication via interface

Device Control Protocol DCP

The communication between the controller and the module works according to the Device Control Protocol DCP, which has been designed for the use of multi-level-hierarchy systems for instruments.

This protocol is working according to the master slave principle. Therefore, the controllers which are on higher hierarchy are working as masters always while devices, which are on lower hierarchy are working as slaves.

In the event of the control of the HV device through a controller the controller will have the master function in this system, while the module (as a Front-end device with intelligence) will be the slave.

The data exchange between the controller and the Front-end (FE) device works with help of data frames. These data frames are assembled of one direction bit DATA_DIR, one identifier bit DATA_ID and further data bytes. The direction bit DATA_DIR defines whether the data frame is a write or read-write access. The DATA_ID carries the information of the type of the data frame and occasionally sub addresses (G0, G1). It is characterised through the first byte of the data frame with bit 7=1. The function of the module as part of a complex system will be defined through the DATA_ID .

In such systems with many hierarchical levels a single function of a single module can be addressed by using group controllers (GC). Then, for each GC on the way to the module the data frame is crated through nesting of the address fields of the GC-addresses followed by the DATA_ID (not necessary in case of control a single module).

EXT_ INSTR	DATA _DIR	DATA_ID Bit								Access
		7	6	5	4	3	2	1	0	
	x	**0**	x	x	x	x	x	x	x	**No** DATA_ID
0/1	**0**	1	0	x	x	x	x	x	x	**Write access** on Front-end device
0/1	**1**	1	0	x	x	x	x	x	x	**Read-write access** on Front-end device (Request at Write)
0/1	**0**	1	1	x	x	x	x	**G1**	**G0**	**Write access** on group
0/1	**1**	1	1	x	x	x	x	**G1**	**G0**	**Read-write access** on group (Request at Write)
										G0, G1 sub address Only needed if group controller (GC) is used

These data frames correspond to a transfer into layer 3 (Network Layer) respectively layer 4 (Transport Layer) of the OSI model of ISO. The transmission medium is CAN Bus according to specification 2.0A, related to level1 (Physical Layer) and level 2 (Data Link Layer).

The Device Control Protocol DCP has been matched to the CAN Bus according to specification CAN 2.0A, but it is also possible to be matched to further transmission media (e.g. RS232). Therefore specials of layer 1 and 2 are only mentioned if absolutely necessary and if misunderstandings of functions between the Transport Layer and functions of the Data Link Layer may be possible. The communication between the controller and a module on the same bus segment will be described in the operator manual.

Summary of CAN data frames

The 9-channel Module EHQ 9005-F is assembled of two sub-modules (8 channels / 1 channel), each controlled independently via an own CAN identifier.

Following list describes the accesses of the DCP made for one of these sub-modules.

EXT_ INSTR	DATA_ DIR	DATA_ID Bit								Access	read/ write/ active	DATA - Bytes
ID1	ID0	7	6	5	4	3	2	1	0			
	x	**0**	x	x	x	x	x	x	x	**No DATA_ID**		
x	**x**	**1**	**0**	**C1**	**C0**	**N3**	**N2**	**N1**	**N0**	**Single access CHANNEL:**		
1	1/0	1	0	0	0	N3	N2	N1	N0	Current trip	r/w	4
0	1	1	0	0	0	N3	N2	N1	N0	Actual voltage	r	4
0	1	1	0	0	1	N3	N2	N1	N0	Actual current	r	4
0	1/0	1	0	1	0	N3	N2	N1	N0	Set voltage	r/w	4
0	1	1	0	1	1	N3	N2	N1	N0	Status channel	r	3
		1	**1**	**C3**	**C2**	**C1**	**C0**	**G1**	**G0**	**Group access module**		
1	1	1	1	0	0	0	0	0	0	Voltage supplies and module temp.	r	8
1	1	1	1	0	0	0	1	0	0	free	r	8
1	1	1	1	0	0	1	0	0	0	Existing hardware channels	r	3
1	1	1	1	0	0	1	1	0	0	Channel works according to control	r	3
1	1	1	1	0	1	0	0	0	0	Status4 Sense voltage ≠ Set voltage	r	3
0	1/0	1	1	0	0	0	0	0	0	General status module	r/w a	2
0	1	1	1	0	0	0	1	0	0	Status1 Voltage limit has been exceeded at single channel	r	3
0	1	1	1	0	0	1	0	0	0	Status2 Hardw. current limit has been exceeded at single channel	r	3
0	1/0	1	1	0	0	1	1	0	0	Channel ON / OFF	r/w	3
0	1/0	1	1	0	1	0	0	0	0	Ramp speed	r/w	3
0	0	1	1	0	1	0	1	0	0	Emergency cut-off	w	3
0	1	1	1	0	1	1	0	0	0	Log-on Front-end device in superior layer	a	3
0	0	1	1	0	1	1	0	0	0	Log-off superior layer at Front-end device	w	3
0	1/0	1	1	0	1	1	1	0	0	Bit rate	r/w	3
0	1/0	1	1	1	0	0	0	0	0	Serial number, software release and CAN message configuration	r/w	7/2
0	0	1	1	1	0	0	1	0	0	Set voltage for all channels	w	4
0	1/0	1	1	1	0	1	1	0	0	KILL-enable	r/w	3
0	1/0	1	1	1	1	0	0	0	0	ADC filter setting	r/w	3
0	1	1	1	1	1	0	1	0	0	Module nominal values	r	5
0	1	1	1	1	1	1	0	0	0	Status3 Software current trip has been exceeded at single channel	r	3

C_i: Accesses — N_i 0 to 15: Channel 0 to 15

G_i 0 to 3: Group 0 to 3 Only needed if group controller (GC) is used

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